



Brake Bleeding Theory and Procedure



Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles as well as the personal safety of those performing the repairs. Standard safety procedures and precautions (including use of safety goggles and proper tools and equipment) should be followed at all times to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

INTRODUCTION

Brake Bleeding Theory and Procedure

This edition of our technical writings will give you all the information you need to successfully bleed your brake system. The following topics will be covered:

- When and why you need to bleed your brakes
- The different methods you can use
- The different tools that are available
- The different types of brake fluid and why it is important to keep it sealed

ECS Difficulty Gauge



1 - Easy

Pro - 4

2 - Moderate

Advanced - 3

Bleeding the brakes on your car is quite often thought of as one of the most daunting tasks that you can face. The fact is, it is actually one of the most misunderstood processes. All it requires is a little bit of patience and you will find that it is really a very simple. Once you read and understand these processes, you will be able to successfully bleed a brake system with ease. Thank you for your interest in our technical writings. We appreciate your business!

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BRAKE FLUID WARNINGS

Brake fluid can be extremely dangerous. Always use caution and wear safety glasses when working with brake fluid. All brake fluid containers will have safety and emergency information printed on the label.



Brake fluid is hygroscopic which means it will absorb water from the atmosphere, which will alter it's chemical characteristics and reduce it's effectiveness. It is very important to keep brake fluid containers sealed at all times and only open them when adding fluid.

Brake fluid is extremely damaging to paint, even if it only contacts the surface for a brief moment. We recommend using protective fender covers wherever possible. It is also a very good idea to keep water, a quick detail spray or cleaner, and a soft rag close by. In the event that brake fluid contacts the paint on your car, rinse it off immediately, followed by spraying a detail spray or cleaner on the surface and wiping it clean with a soft rag.



GENERAL PREPARATION AND SAFETY INFORMATION

ECS Tuning cares about your health and safety. Please read the following safety information. This information pertains to automotive service in general, and while it may not pertain to every job you do, please remember and share these important safety tips.

- Park your car in a safe, well lit, level area.
- Shut the engine off and remove the key from the ignition switch.
- Make sure any remote start devices are properly disabled.
- **ALWAYS** wear safety glasses.
- Make sure the parking brake is applied until the vehicle is safely lifted and supported.
- If using an automotive lift, be sure and utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear.
- When lifting a vehicle using a jack, always utilize the factory specified lift points. Lifting a vehicle in an incorrect location can cause damage to the suspension/running gear. **ALWAYS** support the vehicle with jack stands.
- **ALWAYS** read and follow all safety information and warnings for the equipment you are using.



Never get underneath a vehicle that is supported only by a jack. Always make sure that the vehicle is securely supported on jack stands.

BRAKE BLEEDING TOOLS

Brake Fluid Catch Bottle

The most essential of bleeding tools, brake fluid catch bottles are available in a couple of different styles. The bottle shown here, available on our website as [ES#2773388](#), is ideal for manual bleeding or pressure bleeding. It is easy to hold and easy to see through. The 90 degree bleeder nipple is easy to grip, and is made of a soft yet resilient rubber which will easily push on and seal to all sizes of bleeder screws. The angle of the bleeder nipple also keeps the weight of the hose off the bleeder screw, preventing it from falling off. The clear tubing allows you to see brake fluid flow, and more importantly, the presence of air bubbles.



Brake Fluid Catch Bottle

The brake fluid catch bottles shown here, available on our website as [ES#4557](#), are ideal for gravity bleeding or manual bleeding when you are working solo. They are easy to hold and see through. The key feature of these bottles is a stainless steel lanyard which allows you to hang them from the suspension, allowing the bottle to remain connected while you perform other tasks.



BRAKE BLEEDING TOOLS

Pressure Bleeder

Pressure Bleeders are very useful for many brake bleeding applications. They are a quick and efficient way of bleeding brakes, and very helpful when you are working solo. The unit pictured here is available on our website as [ES#1895871](#). It features a high strength plastic bottle with an easily readable gauge on the side and a built in hand pump in the lid. A machined aluminum cap which fits most European master cylinder reservoirs is attached to the flexible brake fluid supply hose.



Vacuum Bleeder

Vacuum Bleeders are also very useful when working solo. The unit shown here is available on our website as [ES#4371](#). It features a high capacity plastic tank with an easily readable gauge on the side and a built in vacuum pump in the lid. The added value of a vacuum bleeder such as this is that it can be used for evacuating any fluid on your car, which makes it a very versatile, valuable tool.



BRAKE BLEEDING TOOLS

Bleeder Wrench

All wrenches are not created equal. Bleeder screws by nature are in tight locations, and quite often they are rusty. They are always very small, so it doesn't take too much rust or corrosion to weaken their structure. Using a 12 point wrench can easily "round" them and give you nothing to grip. The Bleeder Wrench shown here is available on our website as [ES#2598349](#). It features 11mm (a very common size for European cars) 6-point boxed ends. The six point ends will firmly grip bleeder screws, allowing the twisting force to be applied evenly to the threads. A different angle on each end allows for easy access to the bleeders, and on some cars even with the wheels installed.



Pressure Bleeding Kit

Complete brake bleeding kits are also available on our website. We offer different kits which are specifically tailored to your car depending on the brake fluid type. This kit shown here includes a pressure bleeder with a high strength plastic bottle, an easy to read gauge, a built in hand pump, and a pressure port all on the lid. Two brake fluid catch bottles, a Schwaben Brake Bleeder Wrench, and Pentosin Super DOT 4 Brake Fluid is also included. Look up your car at ecstuning.com to find the complete brake bleeding kit for you.



BRAKE FLUID TYPES

There are different types of brake fluid and it can be a very involved topic, but for all practical purposes we only need to concentrate on the basics. Why are there different types of fluid? The greater the demand of your braking system, the greater the requirements of your brake fluid. As automobile and braking technology changed over the years, brake fluid had to change as well. The most common fluid types are DOT 3, DOT 4, DOT 5, and DOT 5.1. Here is an overview:

Poly Glycol Based Brake Fluids

DOT 3 Brake Fluid:

- Minimum Dry Boiling Point of 205 Degrees Celsius
- Minimum Wet Boiling Point of 140 Degrees Celsius
- Can be mixed with DOT 4 and DOT 5.1
- Used in most pre-ABS small cars and light trucks

DOT 4 Brake Fluid:

- Minimum Dry Boiling Point of 230 Degrees Celsius
- Minimum Wet Boiling Point of 155 Degrees Celsius
- Can be mixed with DOT 3 and DOT 5.1
- Used in larger vehicles, light towing vehicles, and ABS braking systems.

DOT 5.1 Brake Fluid:

- Minimum Dry Boiling Point of 260 Degrees Celsius
- Minimum Wet Boiling Point of 180 Degrees Celsius
- Can be mixed with DOT 3 and DOT 4
- Used for severe duty, heavy towing vehicles, and racing

• All of these fluids, DOT 3, DOT 4, and DOT 5.1, can be mixed together

• Most of these fluids are pale yellow in color, but some may be red or blue. Color does not matter, it is primarily added for ease of leak detection.

• All of these fluids, DOT 3, DOT 4, and DOT 5.1 will absorb moisture from the atmosphere. Moisture will reduce the boiling point of the fluid and damage internal components. Always keep the container sealed when you are not adding brake fluid to the system.

• All of these fluids, DOT 3, DOT 4, and DOT 5.1 will damage the paint on a vehicle, even with brief contact. Always use fender covers to protect surrounding areas and remove any spilled brake fluid immediately.

DOT 5 (Silicone) Brake Fluid:

- Dry Boiling Point of 260 Degrees Celsius
- Wet Boiling Point of 180 Degrees Celsius
- Do NOT mix with other brake fluids

Silicone Based Brake Fluid

• Will not damage the paint on a vehicle.



Do NOT mix Silicone brake fluid with other brake fluids.

BRAKE BLEEDING THEORY

In order to understand why you need to bleed your brake system, you must first understand the basics of a hydraulic brake system. In a hydraulic brake system, the mechanical input force from the brake pedal is converted to hydraulic pressure within the master cylinder. The hydraulic pressure is distributed through the brake lines to the brake calipers or wheel cylinders. Since the brake fluid does not compress, the hydraulic pressure created in the master cylinder is therefore transmitted to each wheel.

In a brake system that has air in it, when you apply force to the brake pedal, the force is converted to hydraulic pressure, however the hydraulic pressure acts on the air in the system. The air compresses and as a result, reduced hydraulic pressure is transmitted to each wheel, producing a brake pedal that feels “spongy” and brakes that are ineffective.

It is important to understand the different bleeding procedures and also to realize that it is not uncommon, due to the complexity of today's braking systems as well as the advantages and disadvantages of each method of bleeding, to have to use more than one procedure to remove all the air from the system.

Regardless of the method you use, the goal of each is the same: Force the air out of the brake system.

How often should a brake system be bled? Your brake system will need to be bled every time it is opened, such as when you are replacing a worn out hydraulic component, or when you are installing performance parts, such as one of our Big Brake Kits.

Flushing a brake system should be performed every two years regardless of mileage. Normal wear of the internal components of the brake system will begin to contaminate the fluid, and moisture is also absorbed by the fluid over time, even from opening the cap to fill or check the fluid. Even small amounts of moisture will react with the brake fluid and be very damaging to the expensive components of your brake system. Flushing a brake system can be performed using any of the bleeding procedures described here.

GENERAL BLEEDING PROCEDURE

Before covering the different ways to bleed your brake system, we will first cover general bleeding procedures that will be used regardless of the method you have chosen.

Fill the brake master cylinder with clean fluid from a sealed container.

Make sure all brakes are properly adjusted. Mis-adjusted brakes will make the bleeding process much more difficult because the hydraulic pressure will act on the caliper pistons or wheel cylinders before forcing the fluid and air out of the bleeder screw. Properly adjust drum brakes and make sure all caliper slides and slide pins are free and properly lubricated.

Attach the hose from a bleeder bottle to the bleeder screw on the caliper or wheel cylinder, starting at the RH rear of the vehicle.

Open the bleeder screw, employ whichever method you have chosen to bleed the brakes, when no more air comes through the hose, bleeding is complete.

Bleed the brakes in the following order: RH Rear, LH Rear, RH Front, LH Front. Note: this is the most widely accepted order in which to bleed the brake system. Some vehicles specify a different order, always follow manufacturers instructions.

Monitor the brake fluid level in the master cylinder, make sure it does not run dry or it will take considerable extra time to re bleed the system.

Once bleeding is complete, make sure all bleeder screws are tight, fill the brake fluid reservoir to the proper level, check the feel of the brake pedal, check for leaks, and clean any brake fluid residue using aerosol brake cleaner.

GRAVITY BLEEDING

Gravity bleeding uses the natural gravity flow of the fluid to force the air through the system.

Advantages of Gravity Bleeding:

- You can perform this type of bleeding by yourself.
- The pressure is so low that it will not affect any metering valves and fluid flow will not be restricted.
- You can let one wheel bleed while you work on another, so it can same time.
- It is a very clean way of bleeding with little mess.

Disadvantages of Gravity Bleeding:

- It can be slow.
- In some cases it is not as effective due to brake system design.

The Procedure:

It is as simple as it sounds. Fill the brake fluid reservoir, connect a bleeder bottle to a bleeder screw, open the screw, and let the system bleed. If you have more than one bleeder bottle you can bleed more than one wheel at a time. Keep an eye on the reservoir to make sure it does not run dry and watch the fluid levels in the bleeder bottles. You will see the level in the bleeder bottles increase as the fluid flows out of the system, bringing the air along with it.

MANUAL BLEEDING

Manual bleeding uses the help of an assistant to depress the brake pedal while you open and close the bleeder screws.

Advantages of Manual Bleeding:

- This is one of the most effective methods the majority of the time.
- Your assistant can let you know how the feel of the pedal is improving during the process, saving you from getting in and out of the car.

Disadvantages of Manual Bleeding:

- It requires an assistant (which may not always be available).

The Procedure:

Fill the brake fluid reservoir and have your assistant pump the brake pedal three or four times, then hold pressure on the pedal. Connect a bleeder bottle and open one of the bleeder screws. Have your assistant tell you when the brake pedal sinks to the floor. Make sure they hold the pedal to the floor while you tighten the bleeder screw. Repeat this procedure until no air bubbles are visible in the hose when the bleeder screw is opened, then repeat for the remaining wheels. Have your assistant pump the pedal up and check for pedal firmness in between wheels.

There is an alternate procedure for manual bleeding in which you leave the bleeder screw open while your assistant slowly pumps the brake pedal up and down. This procedure is equally as effective, but you must make sure that the end of the hose which is attached to the bleeder screw remains submerged in brake fluid at all times or air will be drawn back into the brake system.

PRESSURE BLEEDING

Pressure bleeding uses a pressurized tank of brake fluid to apply pressure and force the fluid through the brake system.

Advantages of Pressure Bleeding:

- You can perform this procedure by yourself.
- The pressure bleeder will keep the brake fluid reservoir full at all times during the procedure.
- This method is very effective on most vehicles.
- This is an excellent method of flushing brake fluid.

Disadvantages of Pressure Bleeding:

- On some vehicles, the pressure may not be high enough to bypass some metering valves or ABS valving.
- It can be messy where the pressure bleeder connects to the reservoir. Use extra caution not to allow brake fluid to drip on the car while installing or removing the bleeder on the master cylinder reservoir.
- The master cylinder is usually over full when the procedure is complete. You will have to draw the extra fluid out.

The Procedure:

Connect the pressure bleeder to the brake fluid reservoir and pressurize it according to the bleeder manufacturer's instructions. Connect a bleeder bottle to one wheel at a time and open the bleeder screw. When the fluids flows with no bubbles present, bleeding is complete. Repeat the procedure for the remaining wheels.

VACUUM BLEEDING

Vacuum bleeding uses vacuum in a tank to draw the brake fluid through the system.

Advantages of Vacuum Bleeding:

- It is a very clean method of bleeding. All fluid is drawn out at the bleeder screws, preventing the leaks that can occur between the bleeder bottle hose and the bleeder screw.
- You can perform this procedure by yourself.
- This method is effective on most vehicles.
- Bleeder catch bottles are not required.

Disadvantages of Vacuum Bleeding:

- There is an increased risk of running the master cylinder dry since the fluid may pull through quicker than you expect.
- On some vehicles, the vacuum may not draw the fluid past some metering valves of ABS valving.

The Procedure:

Draw a vacuum in the tank using the vacuum bleeder manufacturer's instructions. Connect the vacuum bleeder hose to one of the bleeder screws and open it. When the fluid flows with no more air bubbles, bleeding is complete. Repeat the procedure for the remaining wheels.

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